

FORM PTO-1390
(REV 10-2000)

U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER

TRANSMITTAL LETTER TO THE UNITED STATES
DESIGNATED/ELECTED OFFICE (DO/EO/US)
CONCERNING A FILING UNDER 35 U.S.C. 371

P/3013-6

U.S. APPLICATION NO. (If known, see 37 CFR 1.5)

09/830308

INTERNATIONAL APPLICATION NO.
PCT/EP00/08232

INTERNATIONAL FILING DATE
23 August 2000

PRIORITY DATE CLAIMED
25.8.99 and 9.9.99

TITLE OF INVENTION ARTICULATED YOKE, METHOD FOR THE PRODUCTION OF A
SUPPORTING SURFACE ENABLING AN EVEN DISTRIBUTION OF LOAD AND ...

APPLICANT(S) FOR DO/EO/US

Hans LINDENTHAL et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).
4. ☐ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
 - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
 - b. ☒ has been communicated by the International Bureau.
 - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
 - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
 - b. ☐ have been communicated by the International Bureau.
 - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
 - d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 16 below concern document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A **FIRST** preliminary amendment.
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:
5 sheets of drawings.
EFS form.

EXPRESS MAIL CERTIFICATE

I hereby certify that this correspondence is being
deposited with the United States Postal Service as Express
Mail Post Office to Addressee (mail label
EL613112761US in an envelope addressed to:
Asst. Commissioner for Patents, Washington, D.C. 20231,
on April 25, 2001.

Dorothy Jenkins

Name of Person Mailing Correspondence

Dorothy Jenkins
Signature

April 25, 2001

Date of Signature

09/830308

PCT/EP00/08232

17. ☒ The following fees are submitted:**BASIC NATIONAL FEE** (37 CFR 1.492 (a) (1) - (5)) :

Neither international preliminary examination fee (37 CFR 1.482)
nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO
and International Search Report not prepared by the EPO or JPO \$1000.00

International preliminary examination fee (37 CFR 1.482) not paid to
USPTO but International Search Report prepared by the EPO or JPO \$860.00

International preliminary examination fee (37 CFR 1.482) not paid to USPTO but
international search fee (37 CFR 1.445(a)(2)) paid to USPTO \$710.00

International preliminary examination fee paid to USPTO (37 CFR 1.482)
but all claims did not satisfy provisions of PCT Article 33(1)-(4) \$690.00

International preliminary examination fee paid to USPTO (37 CFR 1.482)
and all claims satisfied provisions of PCT Article 33(1)-(4) \$100.00

ENTER APPROPRIATE BASIC FEE AMOUNT =**CALCULATIONS** PTO USE ONLY

\$ 860.00

Surcharge of \$130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30
months from the earliest claimed priority date (37 CFR 1.492(e)).

\$

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	24 - 20 =	4	X \$18.00	\$	72.00
Independent claims	2 - 3 =	0	X \$80.00	\$	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ \$270.00	\$	

TOTAL OF ABOVE CALCULATIONS = \$ 932.00

☐ Applicant claims small entity status. See 37 CFR 1.27. The fees indicated above
are reduced by 1/2.

\$

SUBTOTAL = \$ 932.00

Processing fee of \$130.00 for furnishing the English translation later than ☐ 20 ☐ 30
months from the earliest claimed priority date (37 CFR 1.492(f)).

\$

TOTAL NATIONAL FEE = \$ 932.00

Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be
accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property +

\$

40.00

TOTAL FEES ENCLOSED = \$ 972.00

Amount to be

refunded:

\$

charged:

\$

a. ☒ A check in the amount of \$ 972. to cover the above fees is enclosed. **Check No.** 4390

b. ☐ Please charge my Deposit Account No. _____ in the amount of \$ _____ to cover the above fees.
A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any
overpayment to Deposit Account No. 15-0700. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR
1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO.

OSTROLENK, FABER, GERB & SOFFEN, LLP
1180 Avenue of the Americas
New York, NY 10036-8403

Tel: (212) 382 0700

SIGNATURE:

Robert C. Faber

NAME

24,322

REGISTRATION NUMBER

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of

Hans LINDENTHAL et al

Date: April 25, 2001

Serial No.:

Group Art Unit:

Filed:

Examiner:

For: ARTICULATED YOKE, METHOD FOR THE PRODUCTION OF A SUPPORTING
SURFACE ENABLING AN EVEN DISTRIBUTION OF LOAD AND BEARING
ARRANGEMENT

Asst. Commissioner for Patents

Washington, D.C. 20231

AMENDMENT/SUBMISSION

Prior to examination, please amend the application as follows.

FEE CALCULATION

Any additional fee required has been calculated as follows:

_____ If checked, "Small Entity" status is claimed.

	NO. CLAIMS AFTER AMENDMENT		HIGHEST NO. PREVIOUSLY PAID FOR		EXTRA PRESENT		RATE	ADDIT. FEE
TOTAL	24	MINUS	20	* =	4	X	(\$9 SE or \$18)	\$ 72.00
INDEP.	2	MINUS	3	** =	0	X	(\$40 SE or \$80)	\$
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM						X	(\$135 SE or \$270)	\$
* not less than 20 ** not less than 3								TOTAL \$ 72.00

If any additional payment is required, a check which includes the calculated fee of \$ 72.00
(OFGS Check No. 4390) is attached.

In the event the actual fee is greater than the payment submitted or is inadvertently not
enclosed or if any additional fee during the prosecution of this application is not paid, the Patent
Office is authorized to charge the underpayment to Deposit Account No. 15-0700.

CONTINGENT EXTENSION REQUEST

If this communication is filed after the shortened statutory time period had elapsed and no separate Petition is enclosed, the Commissioner of Patents and Trademarks is petitioned, under 37 C.F.R. §1.136(a), to extend the time for filing a response to the outstanding Office Action by the number of months which will avoid abandonment under 37 C.F.R. §1.135. The fee under 37 C.F.R. § 1.17 should be charged to our Deposit Account No. 15-0700.

AMENDMENTS

 X If checked, amendment(s) to the specification and/or claims are submitted herewith.

1. If checked, an abstract is submitted as the last page of Appendix A.

3. Claims:

Please amend claims 4-6, 8, 9, 12-14, 19-21, 23 and 24 pursuant to 37 C.F.R. § 1.121(c)(i) as set forth in the “clean” version attached hereto as Appendix A. Entry is respectfully requested. A version with markings to show the changes made pursuant to 37 C.F.R. § 1.121(c)(ii) is attached hereto as Appendix B.

 If checked, the optional complete set of “clean” claims pursuant to 37 C.F.R. § 1.121(c)(3) is attached hereto as Appendix C.

REMARKS/ARGUMENT

This Preliminary Amendment is submitted to change the multiple dependent claims to single dependent claims in order to reduce the government filing fee.

EXPRESS MAIL CERTIFICATE

I hereby certify that this correspondence is being deposited with the United States Postal Service as Express Mail to Addressee (mail label # EL613112761US) in an envelope addressed to: Asst. Commissioner for Patents, Washington, D.C. 20231, on April 25, 2001:

Dorothy Jenkins

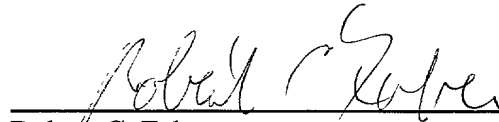
Name of Person Mailing Correspondence


Signature

April 25, 2001

Date of Signature

Respectfully submitted,



Robert C. Faber

Registration No.: 24,322

OSTROLENK, FABER, GERB & SOFFEN, LLP

1180 Avenue of the Americas

New York, New York 10036-8403

Telephone: (212) 382-0700

APPENDIX A
“CLEAN” VERSION OF EACH PARAGRAPH/SECTION/CLAIM
37 C.F.R. § 1.121(b)(ii) AND (c)(i)

CLAIMS (with indication of amended or new):

(Amended) 4. The articulated yoke as claimed in claim 1, wherein the recess (20), observed in the position of installation, is disposed in the surface regions (19) of the supporting surface (10) pointing in the circumferential direction.

(Amended) 5. The articulated yoke as claimed in claim 1, wherein the recess (20) extends in the position of installation parallel to the journal axis (Z1) of the journal (6) mounted in the bore (9) toward to pivot axis (G) over the entire extent of the bore (9).

(Amended) 6. The articulated yoke as claimed in claim 1, wherein the profile of the recess (20) in the supporting surface (10) undergoes a change over the direction of extension of the recess (20) in the direction parallel to the journal axis (Z1) of the journal (6), mounted in the articulated yoke (4) of a journal arrangement (5) toward the pivot axis (G).

(Amended) 8. The articulated yoke as claimed in claim 1, wherein the recesses (20) are arranged symmetrically relative to a plane (E) which is described by the journal axis of the journal (6), mounted in the articulated yoke, of a differential-pinion shaft (3) and the pivot axis(G).

(Amended) 9. The articulated yoke as claimed in claim 1, wherein the supporting surface (10) and/or the surface of the supporting surface (10) that can be described by the recess (20) are surface-treated.

(Amended) 12. The articulated yoke as claimed in claim 1, wherein the latter comprises at least two yoke halves (4.1), each yoke half (4.1) having a leg member and a bearing part.

(Amended) 13. The articulated yoke as claimed in claim 1, wherein the bore (9) is designed as a blind hole.

(Amended) 14. A method for the production of a supporting surface (10) for the achievement of a uniform load distribution of rolling elements of a roller-bearing arrangement for the mounting of journals (6) of a differential-pinion shaft (3) in an articulated yoke (4) having a local recess (20), as claimed in claim 1, wherein, relative to the machining of the bore (9) in the articulated yoke (4), the tool spindle used is guided, with respect to its guide axis A, in an inclined manner relative to the theoretical median axis A_L of a cylindrical bore.

(Amended) 19. The bearing arrangement as claimed in claim 16, wherein the recess, observed in the position of installation, is disposed in the surface regions of the supporting surface pointing in the circumferential direction.

(Amended) 20. The bearing arrangement as claimed in claim 16, wherein the recess extends in the position of installation parallel to the journal axis of the journal mounted in the bore toward the pivot axis over the entire extent of the bore.

(Amended) 21. The bearing arrangement as claimed in claim 16, wherein the profile of the recess in the supporting surface undergoes a change over the direction of extension of the recess in the direction parallel to the journal axis of the journal, mounted in the articulated yoke of a journal arrangement toward the pivot axis.

(Amended) 23. The bearing arrangement as claimed in claim 16, wherein the recesses are arranged symmetrically relative to a plane (E) which is described by the journal axis of the journal, mounted in the articulated yoke, of a differential-pinion shaft and the pivot axis (G).

(Amended) 24. The bearing arrangement as claimed in claim 16, wherein the supporting surface (10), and/or the surface of the supporting surface (10) that can be described by the recess (20) are surface-treated.

APPENDIX B

VERSION WITH MARKINGS TO SHOW CHANGES MADE

37 C.F.R. § 1.121(b)(iii) AND (c)(ii)

CLAIMS:

4. The articulated yoke as claimed in [one of claims 1 to 3] claim 1, wherein the recess (20), observed in the position of installation, is disposed in the surface regions (19) of the supporting surface (10) pointing in the circumferential direction.

5. The articulated yoke as claimed in [one of claims 1 to 4] claim 1, wherein the recess (20) extends in the position of installation parallel to the journal axis (Z1) of the journal (6) mounted in the bore (9) toward to pivot axis (G) over the entire extent of the bore (9).

6. The articulated yoke as claimed in [one of claims 1 to 5] claim 1, wherein the profile of the recess (20) in the supporting surface (10) undergoes a change over the direction of extension of the recess (20) in the direction parallel to the journal axis (Z1) of the journal (6), mounted in the articulated yoke (4) of a journal arrangement (5) toward the pivot axis (G).

8. The articulated yoke as claimed in [one of claims 1 to 7] claim 1, wherein the recesses (20) are arranged symmetrically relative to a plane (E) which is described by the journal axis of the journal (6), mounted in the articulated yoke, of a differential-pinion shaft (3) and the pivot axis (G).

9. The articulated yoke as claimed in [one of claims 1 to 8] claim 1, wherein the supporting surface (10) and/or the surface of the supporting surface (10) that can be described by the recess (20) are surface-treated.

12. The articulated yoke as claimed in [one of claims 1 to 11] claim 1, wherein the latter comprises at least two yoke halves (4.1), each yoke half (4.1) having a leg member and a bearing part.

13. The articulated yoke as claimed in [one of claims 1 to 12] claim 1, wherein the bore (9) is designed as a blind hole.

14. A method for the production of a supporting surface (10) for the achievement of a uniform load distribution of rolling elements of a roller-bearing arrangement for the mounting of journals (6) of a differential-pinion shaft (3) in an articulated yoke (4) having a local recess (20), as claimed in [one of claims 1 to 13] claim 1, wherein, relative to the machining of the bore (9) in the articulated yoke (4), the tool spindle used is guided, with respect to its guide axis A, in an inclined manner relative to the theoretical median axis A_L of a cylindrical bore.

19. The bearing arrangement as claimed in [one of claims 16 to 18] claim 16, wherein the recess, observed in the position of installation, is disposed in the surface regions of the supporting surface pointing in the circumferential direction.

20. The bearing arrangement as claimed in [one of claims 16 to 19] claim 16, wherein the recess extends in the position of installation parallel to the journal axis of the journal mounted in the bore toward the pivot axis over the entire extent of the bore.

21. The bearing arrangement as claimed in [one of claims 16 to 20] claim 16, wherein the profile of the recess in the supporting surface undergoes a change over the direction of extension of the recess in the direction parallel to the journal axis of the journal, mounted in the articulated yoke of a journal arrangement toward the pivot axis.

23. The bearing arrangement as claimed in [one of claims 16 to 22] claim 16, wherein the recesses are arranged symmetrically relative to a plane (E) which is described by the journal axis of the journal, mounted in the articulated yoke, of a differential-pinion shaft and the pivot axis (G).

24. The bearing arrangement as claimed in [one of claims 16 to 24] claim 16, wherein the supporting surface (10), and/or the surface of the supporting surface (10) that can be described by the recess (20) are surface-treated.

Articulated yoke, method for the production of a supporting surface enabling an even distribution of load and bearing arrangement

The invention relates to an articulated yoke, having in detail the features of the preamble of claim 1; also to a method for the production of a supporting surface for the achievement of a uniform distribution of load over the rolling members of a bearing arrangement for journals of differential-pinion shafts in an articulated yoke and a bearing arrangement for mounting a journal in an articulated yoke.

Articulated yokes for use in universal-joint propeller shafts serve to provide the coupling between a machine element on the drive side and a machine element on the take-off side. To this end, they have at least one leg member which can be coupled to the machine element on the drive side or take-off side and bearing parts for supporting the journal of a differential-pinion shaft used for torque transmission. The articulated yoke can be in one part or a plurality of parts, preferably two parts in the form of two yoke halves, each comprising a leg member and a bearing part. Mountings for journals of differential-pinion shafts in the articulated yoke or in the individual yoke halves are known in a plurality of embodiments for a variety of examples of

use. In this context, reference is made to the following representative publications:

1. Offprint, Voith, *Forschung und Konstruktion [Research and Design]*, Vol. 33 (1989, Essay 10, "Entwicklung wälzgelagerter Gelenkwellen für die Hauptantriebe schwerer Walzgerüste" ["Development of roller-mounted universal-joint propeller shafts for the main drives of heavy roll spans"])
2. DE 35 44 253 C1
3. DE 34 46 495 C2

These publications disclose embodiments of universal-joint arrangements for universal-joint propeller shafts in which, for the disposal of the differential-pinion propeller shaft in the articulated yoke, the bearing arrangement provided therefor comprises at least one radial bearing and, preferably, an axial bearing in addition. The radial bearing is designed as a roller bearing and comprises at least one inner and one outer ring, these forming the respective running tracks for the roller members. The problems of these bearing arrangements for the journals of differential-pinion shafts of universal-joint propeller shafts substantially lie in the fact that the individual roller bearings are stressed by high torque impacts and, at the same time, transverse accelerations. In such cases, the impact-like stresses with high and rapidly changing angles of bending cause elastic

deformations in the articulated yoke both in the region of the leg or connecting members and within the bore of the bearing part. The bore widens and generally adopts a noncircular shape. The greatest deformation of the differential-pinion shaft is, however, caused by the introduction of circumferential force. Its direction fluctuates with the positive or negative value of the operational angle of bending and also changes with each reversing operation. These influences of operational and design factors cause alignment errors with an unfavorable distribution of load into the bearings, specifically a mismatch of the bore/oblique position of the bore, flexion of the journal, a radial play in the roller bearing and the spring deflection of the roller bearing. These problems have a particular effect with a relatively rigid bearing surround in the articulated yoke and when used in heavy universal-joint propeller shafts. The consequence thereof is a nonuniform radial pressure distribution in the bore, which leads from linear to spot contact at the contact points of the roller members of the radial bearing and to excessive edge stresses.

The greatest deformation during operation when used in universal-joint drive shafts takes place in the region of the roots of the individual journals of a differential-pinion shaft, since in this case the curvature of the line of bending analogous to the bending moment is at its greatest.

For the radial bearing, this results, under the influence of the circumferential force, in an increased stressing of the roller members in the circumferential direction in the region of the bore, which causes increased edge stresses in a segment of the radial bearing, while lifting of the rollers is observable in the opposite segment. This results in a dramatic reduction of the bearing index.

The nonuniform bearing performance also results in a nonuniform loading of the individual elements of the bearing arrangement, particularly of the running tracks. This is characterized by removal of material in the region of the highly stressed points. In order to avoid this, the running tracks have in the past been subjected to an appropriate surface treatment, which is intended very largely to avoid the adverse effects of a nonuniform introduction of load. This solution, however, is very cost-intensive. Furthermore, such a solution only allows limited use of standardized bearing arrangements for universal-joint propeller shafts.

In order to prevent the reduction of the bearing index, the individual embodiments in the above-mentioned publications propose solutions which, in terms of design embodiment, especially in terms of the interpretation of the individual structural elements, are always based on the deformation travels possibly arising, in order, by means of an actually desirable rigid bearing connection structure, to achieve a good bearing configuration and hence a long service

life of the bearing. Such solutions are, however, very laborious to manufacture and hence also cost-intensive.

It is therefore an object of the present invention to provide a solution enabling the most uniform possible distribution of load over the bearing arrangement for the mounting of journals of differential-pinion shafts in articulated yokes of universal-joint propeller shafts which is characterized by a simple construction and a small number of components. Furthermore, the proposed solution is intended to be characterized by a low production engineering effort and low costs.

The solution according to the invention is characterized by the features of claims 1, 14 and 16. Advantageous embodiments are reproduced in the respective dependent claims.

The articulated yoke for use in universal-joint propeller shafts comprises at least one leg member for connection to a machine element on the drive side or take-off side and at least one bearing part, with a bore for mounting a journal of a differential-pinion shaft arrangement. The bore forms a supporting surface for at least one part of a roller-bearing arrangement for mounting a journal of differential-pinion shafts. According to the invention, the supporting surface has a local recess at least in the region of the roller members of the roller-bearing arrangement that, in the mounted state, are most highly stressed during torque transmission.

The position and/or the profile of the recess is determined by the load situation, which can be characterized by at least one of the parameters listed below:

- a) level of the force to be transmitted and/or
- b) geometry of the bearing connection elements, especially differential-pinion shaft, articulated yoke and/or
- c) deformations or deformation travels under load, in particular of the bearing connection elements articulated yoke and differential-pinion shaft and of the individual elements of the bearing arrangement, in particular roller members, and/or
- d) bearing play.

As a result of the solution according to the invention, it becomes possible, during power transmission, for the radial forces to be introduced almost uniformly into the bearing arrangement by the differential-pinion shaft mounted in the articulated yoke and transmitted to the bearing connection elements, in other words the articulated yoke. The bore of the articulated yoke, which is incorporated into the bearing part of the articulated yoke, undergoes substantial relief from load here, in the region of about 40%. The individual roller members undergo virtually uniform placement on the outer running track under the influence of the circumferential force in the circumferential direction with deformation of the differential-pinion shaft, and with the influence of the circumferential force, which results in uniform rolling and hence uniform force transmission to the

element bearing the outer running track and the element adjoining the latter.

The solution according to the invention is further characterized by a low design and production engineering input. The increase in service life of the bearing arrangements achievable by means of this solution, by providing a supporting surface for the uniform distribution of load on the roller members, amounts to about 40%. The abrasion otherwise caused to the outer circumference of the bearing arrangement in conventional embodiments with a parallel supporting surface is avoided by the provision of local recesses in the supporting surface, in the regions which serve to support the rolling elements or roller members that are most highly stressed, since in this region the forces acting on the supporting surface are reduced, inter alia, by deformation.

The solution according to the invention is applicable to articulated yokes which are of one-part or multipart design. In the former case, the articulated yoke comprises a leg member and two bearing parts, each having a bore. In the latter case, each yoke half comprises a leg member and a bearing part, the two yoke halves being capable of being connected in the axial and/or radial direction.

Preferably, depending on the load to be theoretically expected, the recesses in the supporting surface, viewed in the installed position and in the condition of operation during transmission of torque, are arranged in the surface

regions of the supporting surface pointing in the circumferential direction.

In a further advantageous embodiment, the arrangement of the local recesses in the supporting surface is symmetrical with respect to the journal axis of the journal of a differential-pinion shaft mounted in the articulated yoke and/or symmetrical with respect to a plane which can be described by the pivot axis and the journal axis of the journal mounted in the articulated yoke. The symmetrical design of the supporting surface permits use in a universal-joint propeller shaft irrespective of the desired direction of rotation of the universal-joint propeller shaft, which in this case need not be heeded when the articulated yokes are installed.

There are a great many possible embodiments of the recesses to be provided locally in the supporting surface. The recess can be described by one or more of the parameters listed below:

- a) profile of the recess parallel to the journal axis of the journal to be mounted in the articulated yoke, viewed toward the pivot axis, in a plane oriented perpendicularly to the plane described by the pivot axis and the journal axis, and/or
- b) extent of the recess viewed toward the pivot axis parallel to the journal axis, and/or
- c) extent of the recess viewed in the radial direction relative to the journal axis in the installed position

- of the journal, in particular in the circumferential direction of the supporting surface, and/or
- d) change in profile over the extent in the direction of the pivot axis parallel to the journal axis, and/or
 - e) change in direction of the extent of the recess in the circumferential direction.

The profile in turn is characterized by profile depth, profile width and shape. Preferably, profile patterns are generated that can be produced in a simple manner, if possible in one working step. In a preferred embodiment, the profile width and the profile depth diminish when viewed from the outer surface of the articulated yoke toward the pivot axis parallel to the journal axis of the journal mounted in the articulated yoke. In this embodiment, the particularly high stresses on the bearing parts disposed in the region of the outer surface of the articulated yoke are dramatically reduced.

In a further development, provision is made for the surface of the supporting surface to be subjected to a special surface treatment. This surface treatment serves to influence the mechanical properties of the structural element of the articulated yoke in the region of the bore.

According to a further aspect of the invention, provision is made for the supporting surface or one part of the supporting surface to be provided with a perforation. As a result, the supporting structure as a whole becomes

elastically or plastically deformable, so that the force peaks are reduced by the work of deformation.

Preferably, an embodiment of the recess is selected which can be generated with the minimum possible working effort, in other words a small number of processing steps, from the bore that is already present. Possible working methods used here are those listed below:

- grinding
- milling
- the use of CNC spindles, for which a geometry deviating from circular geometry is programmed
- erosion, especially spark erosion
- compression
- application of coating material, for example chroming
- shaving
- perforation.

In the simplest case, the tool spindle used to generate the bore in order to generate the recess in the circumferential direction is merely inclined through a particular angle about the journal axis of the journal of a differential-pinion shaft, to be mounted in the articulated yoke, which corresponds to the theoretical median axis of the bore and the processing operation is performed again.

The solution according to the invention is, moreover, suitable for any design of articulated yokes. It is immaterial here whether the bore is of continuous form or has

a closed design, meaning that the bore is merely drilled into the articulated yoke as a blind hole.

According to a further idea for a solution, the local recess is made even in the outer ring of the radial bearing in the region of the rolling elements that are most highly stressed during torque transmission.

The solution according to the invention is explained below with reference to figures. In the figures, in detail:

Figure 1 illustrates in a diagrammatically simplified view a yoke half designed according to the invention with a recess in the supporting surface;

Figs. 2a illustrate, when compared, the problems of and 2b nonuniform stressing of the roller members during torque transmission in the circumferential direction, considered for a conventional bearing design from the prior art with running surfaces of cylindrical, in other words mutually parallel, design and the force distribution arising for use in heavy-duty universal-joint propeller shafts and the force distribution arising in the case of a bore designed according to the invention; and

Figure 3 illustrates in a diagrammatically simplified view, with reference to a sectional view through a yoke

half, a preferred method of producing the supporting structure.

Figures 2a1 to 2a4 illustrate in a diagrammatically simplified view, and not to scale, the deformations arising in the bore in the case of a conventional design of an articulated yoke with a cylindrical supporting surface, and hence the distribution of forces in the bearing arrangement. For this purpose, an extract from a universal-joint arrangement 1 for a journal bearing 2 is shown (not to scale) in the installed position in a sectional view through a differential-pinion shaft 3 mounted in the articulated yoke 4 in a plane describable by the journal axis Z1 and perpendicular to the pivot axis G. Figures 2a1 and 2a2 merely illustrate here the mounting of the journal 6 of the journal arrangement 5 in a first yoke half 4.1 of the articulated yoke. The initial positions, without load, of the individual bearing connection elements, differential-pinion shaft 3 and yoke half 4.1, are illustrated here in broken lines. The continuous lines illustrate the deformations arising at the bearing connection elements, differential pinion shaft 3 and yoke half 4.1, under the influence of the circumferential force. The yoke half 4.1 comprises a leg member 7 and a bearing part 8, in which a bore 9 is disposed. The bore 9 here forms a supporting surface 10 for supporting at least part of a roller bearing arrangement, not shown here in detail, for mounting the journal 6 of the differential-pinion

shaft 3 in the bore 9 of the yoke half 4.1. The effect of the oblique position β_B of the bore arising because of the angle of inclination α of the journal bending line is that the individual elements of the roller-bearing arrangement, not shown here in detail, which is provided in the bore 9 for mounting the journal 6, cannot be appropriately guided parallel to one another under load, an inclination of the elements of the bearing arrangement bearing the running track and hence of the roller members, taking place. Under the influence of the circumferential force, a displacement f_B of the bore 9 also occurs. The overall travel of the displacements arising is characterized by f_G . γ in figure 2a indicates the total angle of twist.

The force distributions for the roller-bearing arrangement 11 resulting from these deformations illustrated are reproduced in two views in figures 2a3 and 2a4. Figure 2a3 illustrates a view in accordance with figure 2a2, while figure 2a4 again illustrates the view in accordance with figure 2a1 but with the roller-bearing arrangement 11 shown and an extract from the differential-pivot shaft without yoke half.

The roller-bearing arrangement 11 comprises at least one radial bearing 12, each bearing having an outer ring 13, the rolling elements 14 and an inner ring 15. The inner ring 15 here forms a first inner running surface 16 for the rolling elements 14, while the outer ring 13 forms a second outer running surface 17 for the rolling elements 14. The

presence of an inner ring 15 and/or outer ring 13 is not absolutely necessary. Embodiments of the roller-bearing arrangement 11 are also conceivable in which the bearing connection elements, in detail the differential-pinion shaft 3 or journal 6 and the yoke half 4.1, function as elements supporting running tracks.

It is apparent from figures 2a3 and 2a4 that, under the influence of the circumferential force, the force distribution onto the rolling elements 14 of the roller-bearing arrangement 11 is greatest in the region of the outer surface 18 of the yoke half 4.1 and in the surface regions of the supporting surface 10 that point in the circumferential direction and are here designated 19. The forces here arise from the compressive stresses acting on the supporting surface 10, which in turn are determined by the axial load, bending and radial load. The circumferential force or tangential force on the rolling elements 11 toward the supporting surface 10 is greatest in those regions which, viewed in the circumferential direction, based on the axis of symmetry S_{GM} of the yoke half 4.1, which extends perpendicularly to the axis of the bore, which corresponds to the journal axis Z1 of the journal 6 of the journal arrangement 5 mounted in the bore 9, are arranged symmetrically, a lifting of the rolling elements 14 is observable. This partial contact of the rolling elements 14 on the running tracks, or on the elements forming the running tracks for the rolling elements 14, in particular on the

outer ring 13 and the inner ring 15, results in a reduction of the bearing capacity of the entire roller-bearing arrangement 11. The nonuniform stresses on the bearing connection elements, in particular the bearing part 8 of the yoke half 4.1, result in corresponding fatigue phenomena in the highly stressed regions.

According to the invention, therefore, it is proposed that the supporting surface 10, which is formed by the bore 9, be provided with recesses 20 locally in the regions which support the most highly stressed rolling elements 14 of the roller-bearing arrangement 11. For reasons of clarification, the yoke half 4.1 is reproduced in section in the case illustrated, while the local recess 20 made in the supporting surface 10 is reproduced with double hatching. It becomes apparent from this that the local recess 20 extends substantially from the outer surface 18 of the yoke half 4.1 toward the pivot axis parallel to the journal axis Z1, preferably, as shown in Figure 1a, over the entire extent of the bore 9 in the direction parallel to the journal axis Z1. Furthermore, the recess 20 extends in the circumferential direction, in other words in the radial direction based on the journal axis Z1 viewed in the bore 9. The extent in the circumferential direction occurs here via the extent of different size toward the pivot axis C parallel to the journal axis Z1. In accordance with the load arising according to Figures 2a3 and 2a4 in a conventional embodiment with cylindrical bore 9, the recess 20 possesses the maximum

dimensions in terms of depth t and extent in the circumferential direction, here designated as width b , in the region of the outer surface 18 of the yoke half 4.1 in the bore 9. These dimensions diminish here in the direction of the pivot axis. The force distribution achievable in the bore with this supporting structure is shown in figures 2b1 and 2b2.

Figure 1b illustrates in section, with reference to two views I-I and II-II, in contrast with one another, the change in the profile pattern of the recess 20 toward the pivot axis G parallel to the journal axis Z1 starting from the outer surface 18 of the yoke half 4.1. It becomes apparent from this that the profile width b_1 and the profile depth d_1 are designed to be much greater in the region of the outer surface 18 of the yoke half 4.1 than in the region of the inner surface 22 of the yoke half 4.1. The dimensions in this region are designated b_2 and t_2 .

The embodiment of a recess 20 shown in figures 1a and 1b represents a preferred design. The solution according to the invention is not, however, tied to this embodiment. Modifications are conceivable in the presentation of the profile, especially as regards the shape of the profile of the recess and/or the design of the profile in respect of its width, depth and length, in other words its extent in the direction of the pivot axis G parallel to the journal axis Z1 of the journal mounted in the yoke half 4.1. The specific design of the recess 20 depends here on the specific

individual case and is left to the discretion of the responsible person skilled in the art. The size of the local recess in the supporting surface is determined here by at least one of the parameters listed below, but preferably the combination of the individual parameters:

- level of the force to be transmitted
- geometry of the bearing connection elements, bearing housing or yoke half and differential-pinion shaft
- deformation of the bearing connection elements under load, especially of the yoke half, the differential-pinion shaft and the rolling elements or the elements bearing the running surfaces for the rolling elements
- bearing play.

The solution according to the invention of providing local recesses in the supporting surface of the bore differs substantially here from the precise bore or circular geometry normally required. The profile of the recess cut into the supporting surface covers in this case about 1/10 to 5/10 of the supporting surface. The specific position, viewed in the circumferential direction of the bore, and the specific design of the profile as regards shape, depth, breadth and length are determined by the load situation, which can be described by the parameters listed above.

Figure 3 illustrates, in a diagrammatically simplified view with reference to an extract from a yoke half 4.1, which is reproduced in sectional view, the interaction with a tool 23 for machining the bore 9, especially the

supporting surface 10 for incorporating the recesses 20 to be provided according to the invention. The incorporation of the recesses 20 takes place here by the interaction of a tool spindle 24 with the bore 9. The tool spindle 24 has a diameter d which corresponds to the diameter of the bore. The bore can also be already cut into the yoke half 4.1 with this tool spindle 24. The cutting of the bore takes place here by guiding the tool spindle 24 with its axis A corresponding to the bearing axis or median axis A_L theoretically appropriate for the cylindrical embodiment of the bore 9, which corresponds to the journal axis $Z1$ of the journal mounted in the articulated yoke. The incorporation of the recess 20 into the support surface 10 which is formed by the bore 9 then takes place by inclining the axis of the tool spindle A relative to the theoretical median axis of the bore 9 which, in the installed position of the journal, corresponds to the journal axis $Z1$ of the journal mounted in the articulated yoke. The angle of inclination E here indicates, in accordance with its size and direction based on a plane E which can be described by the journal axis $Z1$ of the journal theoretically mounted in the yoke half 4.1 and the pivot axis G which corresponds to the axis of symmetry or axis of rotation of the universal-joint propeller shaft, the position and size of the recess 20 produced in the supporting surface 10 of the bore 9 and, correspondingly, the improvement in the force distribution in the roller-bearing arrangement under load as compared with a conventionally designed bearing

arrangement, in particular a bore 9 with a cylindrical supporting surface.

Preferably, the remachining of the bore 9 is done by milling. Other methods of machining are, however, also conceivable, such as, for example grinding, erosion, compression, especially percussion compression, shaving and perforation, it being possible in the last-named case for the supporting structure to be designed to be elastically or plastically deformable by means of the provision of a perforation.

Patent Claims

1. Articulated yoke (4) for use in universal-joint propeller shafts;

1.1 having at least one leg member for coupling to a machine element on the drive side or take-off side;

1.2 having at least one bearing part (8), surrounding a bore (9), which forms a supporting surface for supporting at least one partial region of a roller-bearing arrangement (11) for the positioning of a journal (6) of a differential-pinion shaft (3) in the articulated yoke (4);

characterized by the following feature:

1.3 the supporting surface (10) has a local recess at least in the region of the rolling elements (14) of the roller-bearing arrangement (11) that are most highly stressed in the mounted state during torque transmission.

2. The articulated yoke as claimed in claim 1, wherein the position and/or the profile, or the shape and/or the size, of the recess are determined as a function of at least one parameter directly characterizing the load situation.

3. The articulated yoke as claimed in claim 2, wherein at least one of the parameters listed below is used as a parameter for characterizing the load situation:

- the size of the force to be transmitted and/or

- the geometry of the connecting parts of the roller-bearing arrangement and/or
- the distortion of the connecting elements of the roller-bearing arrangement and/or
- the bearing play.

4. The articulated yoke as claimed in one of claims 1 to 3, wherein the recess (20), observed in the position of installation, is disposed in the surface regions (19) of the supporting surface (10) pointing in the circumferential direction.

5. The articulated yoke as claimed in one of claims 1 to 4, wherein the recess (20) extends in the position of installation parallel to the journal axis (Z1) of the journal (6) mounted in the bore (9) toward the pivot axis (G) over the entire extent of the bore (9).

6. The articulated yoke as claimed in one of claims 1 to 5, wherein the profile of the recess (20) in the supporting surface (10) undergoes a change over the direction of extension of the recess (20) in the direction parallel to the journal axis (Z1) of the journal (6), mounted in the articulated yoke (4) of a journal arrangement (5) toward the pivot axis (G).

7. The articulated yoke as claimed in claim 6, wherein the change of profile of the recess (20) undergoes a reduction in the direction parallel to the journal axis (Z1) of the journal (6) mounted in the articulated yoke (4), of the differential-pinion shaft (3) with regard to its width in

the circumferential direction of the bore (9) and its extent in the direction of the extension of the bore (9) toward the pivot axis (G).

8. The articulated yoke as claimed in one of claims 1 to 7, wherein the recesses (20) are arranged symmetrically relative to a plane (E) which is described by the journal axis of the journal (6), mounted in the articulated yoke, of a differential-pinion shaft (3) and the pivot axis (G).

9. The articulated yoke as claimed in one of claims 1 to 8, wherein the supporting surface (10) and/or the surface of the supporting surface (10) that can be described by the recess (20) are surface-treated.

10. The articulated yoke as claimed in claim 9, wherein the supporting surface (10) and/or the recess (20) are provided with a perforation.

11. The articulated yoke as claimed in claim 10, wherein the recess (20) is treated by percussion compression.

12. The articulated yoke as claimed in one of claims 1 to 11, wherein the latter comprises at least two yoke halves (4.1), each yoke half (4.1) having a leg member and a bearing part.

13. The articulated yoke as claimed in one of claims 1 to 12, wherein the bore (9) is designed as a blind hole.

14. A method for the production of a supporting surface (10) for the achievement of a uniform load distribution of rolling elements of a roller-bearing arrangement for the mounting of journals (6) of a differential-pinion shaft (3)

in an articulated yoke (4) having a local recess (20), as claimed in one of claims 1 to 13, wherein, relative to the machining of the bore (9) in the articulated yoke (4), the tool spindle used is guided, with respect to its guide axis A, in an inclined manner relative to the theoretical median axis A_L of a cylindrical bore.

15. The method as claimed in claim 14, wherein the position of the recesses (20) and their dimensions are in each case determined by the extent of the angle of inclination between the guide axis of the tool spindle (24) and the theoretical median axis A_L of the bore (9) and the direction of inclination.

16. A bearing arrangement for the positioning of differential-pinion shafts in an articulated yoke (4) for use in universal-joint propeller shafts;

16.1 having a radial bearing disposed in a bore in the bearing part of the articulated yoke and comprising a plurality of rolling elements, a first element forming an outer running surface and a second element forming an inner running surface;

16.2 the outer running surface forms a first supporting surface and the inner running surface a second supporting surface for the rolling elements;

characterized by the following features:

16.2 the first supporting surface has a local recess at least in the region of the rolling elements of the radial bearing that are most highly stressed in the mounted state during torque transmission.

17. The bearing arrangement as claimed in claim 16, wherein the position and/or the profile, or the shape and/or the size, of the recess are determined as a function of at least one parameter directly characterizing the load situation.

18. The bearing arrangement as claimed in claim 16, wherein at least one of the parameters listed below is used as a parameter for characterizing the load situation:

- the size of the force to be transmitted and/or
- the geometry of the connecting parts of the roller-bearing arrangement and/or
- the distortion of the connecting elements of the roller-bearing arrangement and/or
- the bearing play.

19. The bearing arrangement as claimed in one of claims 16 to 18, wherein the recess, observed in the position of installation, is disposed in the surface regions of the supporting surface pointing in the circumferential direction.

20. The bearing arrangement as claimed in one of claims 16 to 19, wherein the recess extends in the position of installation parallel to the journal axis of the journal

mounted in the bore toward the pivot axis over the entire extent of the bore.

21. The bearing arrangement as claimed in one of claims 16 to 20, wherein the profile of the recess in the supporting surface undergoes a change over the direction of extension of the recess in the direction parallel to the journal axis of the journal, mounted in the articulated yoke of a journal arrangement toward the pivot axis.

22. The bearing arrangement as claimed in claim 21, wherein the change of profile of the recess undergoes a reduction in the direction parallel to the journal axis (Z1) of the journal mounted in the articulated yoke, of the differential-pinion shaft with regard to its width in the circumferential direction of the bore and its extent in the direction of the extension of the bore toward the pivot axis.

23. The bearing arrangement as claimed in one of claims 16 to 22, wherein the recesses are arranged symmetrically relative to a plane (E) which is described by the journal axis of the journal, mounted in the articulated yoke, of a differential-pinion shaft and the pivot axis (G).

24. The bearing arrangement as claimed in one of claims 16 to 24, wherein the supporting surface (10) and/or the surface of the supporting surface (10) that can be described by the recess (20) are surface-treated.

List of references

- 1 Universal bearing arrangement
- 2 Journal bearing
- 3 Differential-pinion shaft
- 4 Articulated yoke
- 4.1 Yoke half
- 5 Journal arrangement
- 6 Journal
- 7 Leg member
- 8 Bearing part
- 9 Bore
- 10 Supporting surface
- 11 Roller-bearing arrangement
- 12 Radial bearing
- 13 Outer ring
- 14 Rolling elements
- 15 Inner ring
- 16 First inner running surface
- 17 Second outer running surface
- 18 Outer surface of the yoke half
- 19 Surface region
- 20 Recess
- 21 Profile
- 22 Inner surface of the yoke half
- 24 Tool spindle

Z1 Journal axis of the journal mounted in the yoke half

G Pivot axis

F_u Circumferential force

A Axis of the tool spindle

α Angle of inclination of the bending line of the journal

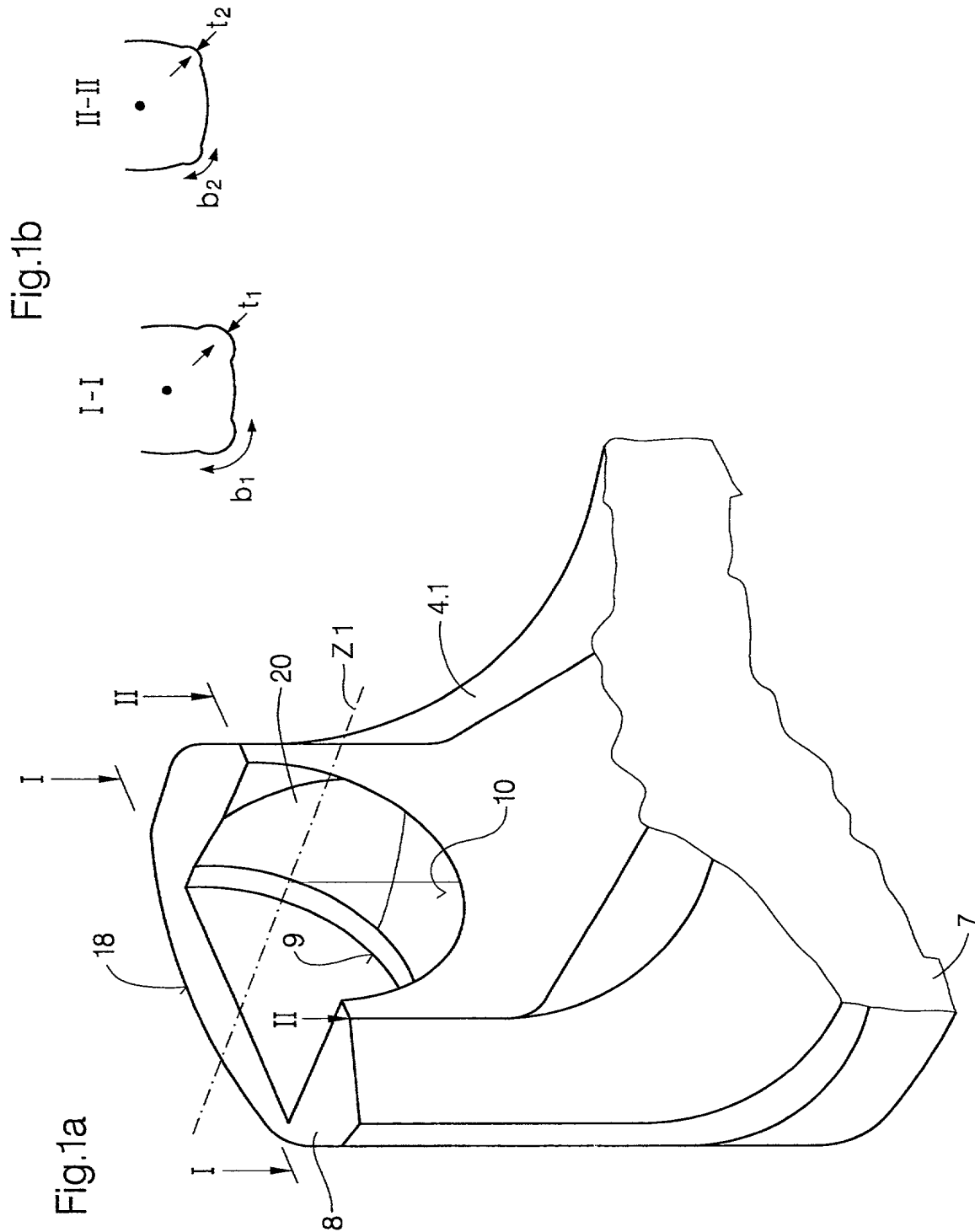
β_B Oblique position of the bearing

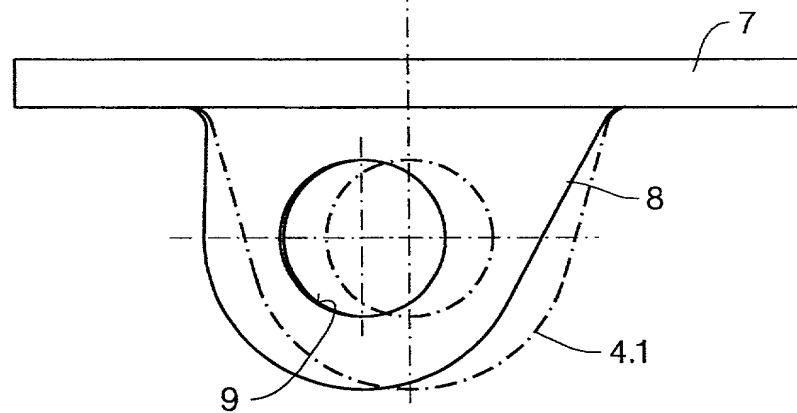
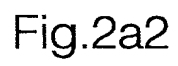
γ Total angle of twist

E Angle between median axis of the bore and axis of symmetry of the tool spindle

f_B Displacement of the bore

f_G Total displacement travel





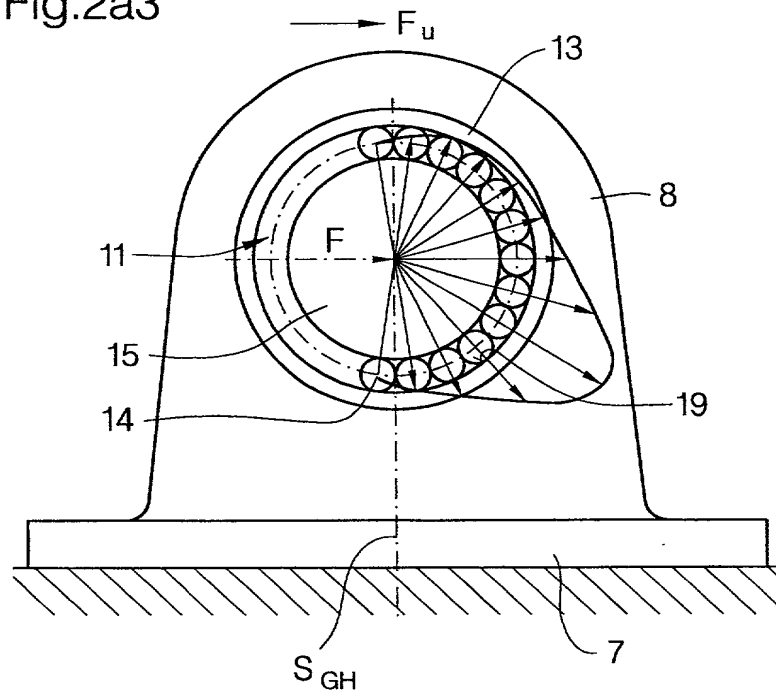
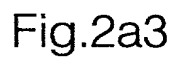


Fig.2b

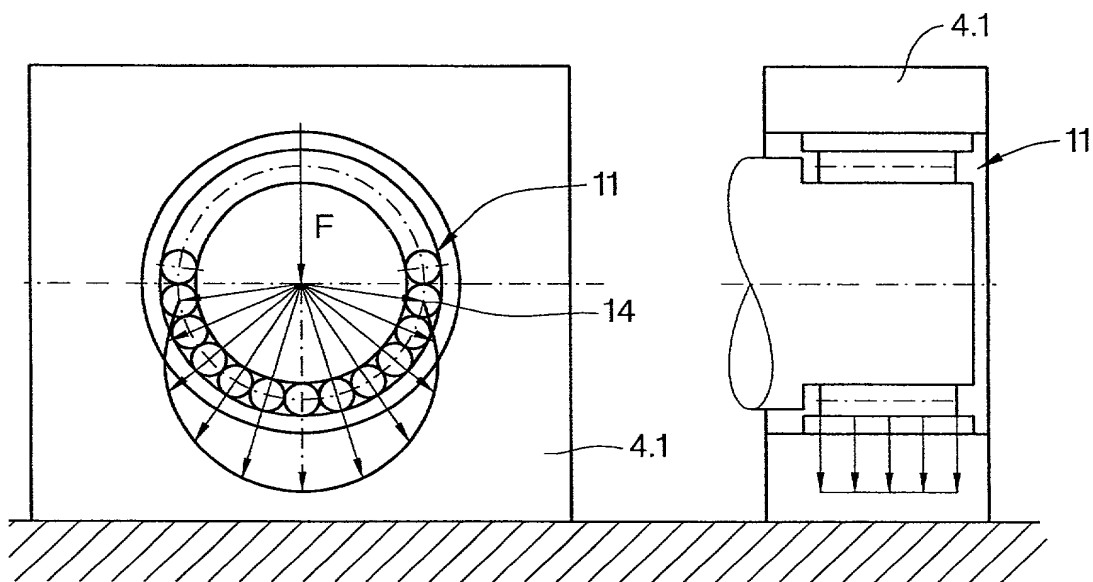
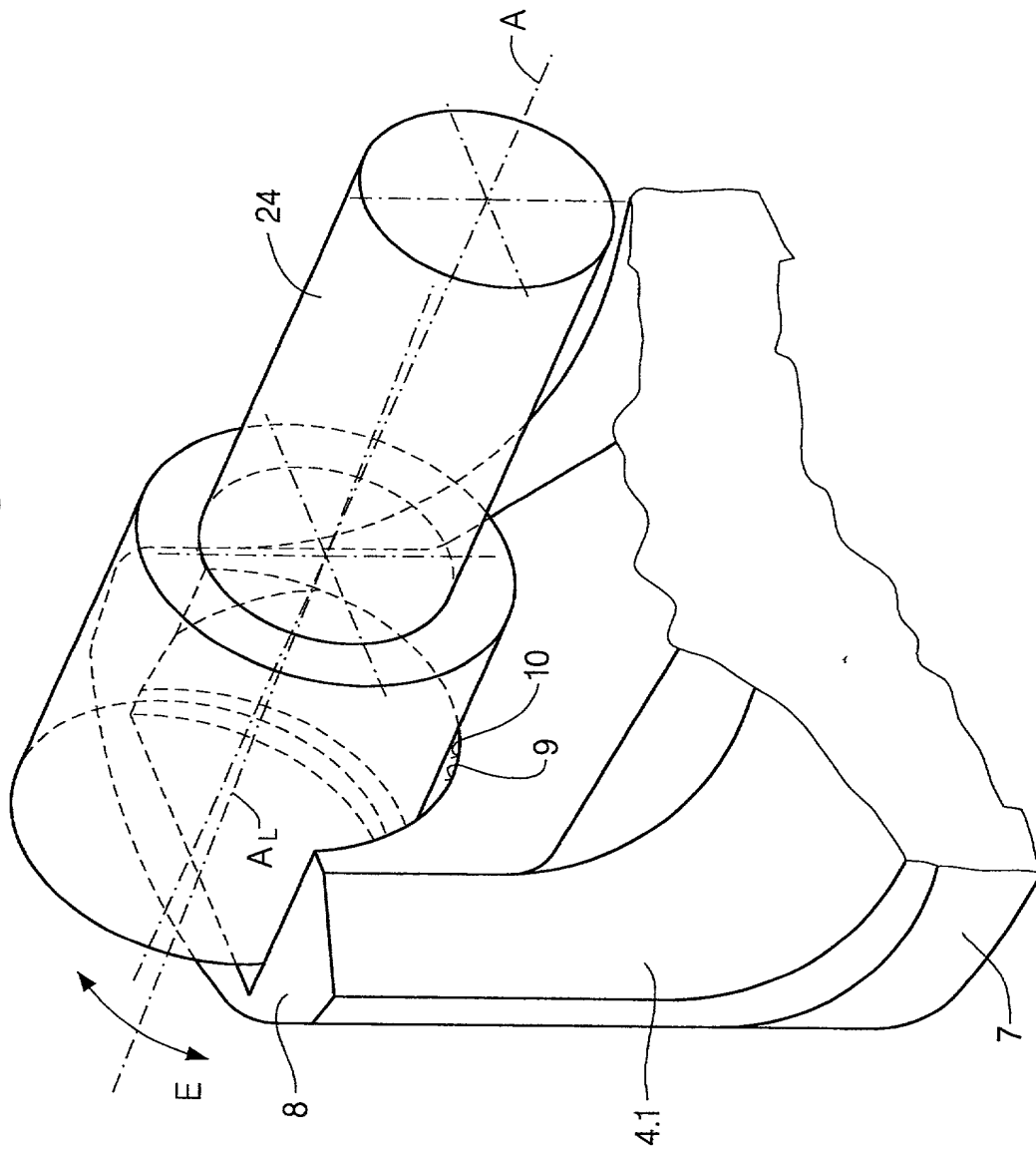


Fig.3



6057845

UNITED STATES OF AMERICA COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION		OFGS FILE NO. P/3013-6																																																					
<p>As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named) of the subject matter which is claimed and for which a patent is sought on the invention entitled:</p> <p>ARTICULATED YOKE, METHOD FOR THE PRODUCTION OF A SUPPORTING SURFACE ENABLING AN EVEN DISTRIBUTION OF LOAD AND BEARING ARRANGEMENT</p> <p>the specification of which is attached hereto, unless the following box is checked:</p> <p><input checked="" type="checkbox"/> was filed on <u>23 August 2000</u> as United States patent Application Number or PCT International patent application number <u>PCT/EP00/08232</u> and was amended on _____ if any).</p> <p>I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.</p> <p>I acknowledge the duty to disclose all information known to be material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56.</p> <p>I hereby claim priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate or United States provisional application(s) listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:</p> <p>Prior Foreign or Provisional Application(s)</p> <table border="1"> <thead> <tr> <th>COUNTRY</th> <th>APPLICATION NUMBER</th> <th>DATE OF FILING (day, month, year)</th> <th>PRIORITY CLAIMED UNDER 35 U.S.C. 119</th> </tr> </thead> <tbody> <tr> <td>Germany</td> <td>299 14 893.9</td> <td>25 August 1999</td> <td>YES <u>X</u> NO _____</td> </tr> <tr> <td>Germany</td> <td>199 53 963.4</td> <td>9 November 1999</td> <td>YES <u>X</u> NO _____</td> </tr> <tr> <td></td> <td></td> <td></td> <td>YES _____ NO _____</td> </tr> </tbody> </table> <p>I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.</p> <table border="1"> <thead> <tr> <th>UNITED STATES APPLICATION NUMBER</th> <th>DATE OF FILING (day, month, year)</th> <th>STATUS (patented, pending, abandoned)</th> </tr> </thead> <tbody> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> <tr><td> </td><td> </td><td> </td></tr> </tbody> </table> <p>I hereby appoint customer no. 2352 OSTROLENK, FABER, GERB & SOFFEN, LLP, and the members of the firm: Samuel H. Weiner - Reg. No. 18,510; Jerome M. Bertiner - Reg. No. 18,653; Robert C. Faber - Reg. No. 24,322; Edward A. Meilman - Reg. No. 24,735; Steven I. Weisburd - Reg. No. 27,409; Max Moskowitz - Reg. No. 30,576; Stephen A. Soffen - Reg. No. 31,063; James A. FINDER - Reg. No. 30,173; William O. Gray, III - Reg. No. 30,944; Louis C. Dujmich - Reg. No. 30,625; Douglas A. Miro - Reg. No. 31,643; and Michael J. Scherer - Reg. No. 34,425, as attorneys with full power of substitution and revocation to prosecute this application, to transact all business in the Patent & Trademark Office connected therewith and to receive all correspondence.</p> <p>SEND CORRESPONDENCE TO: OSTROLENK, FABER, GERB & SOFFEN, LLP 1180 AVENUE OF THE AMERICAS NEW YORK, NEW YORK 10036-8403 CUSTOMER NO. 2352</p> <p>DIRECT TELEPHONE CALLS TO: (212) 382-0700</p> <p>I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application of any patent issued thereon.</p> <table border="1"> <tr> <td colspan="2"> FULL NAME OF SOLE OR FIRST INVENTOR Hans LINDENTHAL </td> <td> INVENTOR'S SIGNATURE <i>Hans Lindenthal</i> </td> <td> DATE 19. April 2001 </td> </tr> <tr> <td colspan="2"> RESIDENCE (City and either State or Foreign Country) D-89522 Heidenheim, Germany </td> <td colspan="2"> COUNTRY OF CITIZENSHIP Germany </td> </tr> <tr> <td colspan="4"> POST OFFICE ADDRESS Kistelbergstrasse 81, D-89522 Heidenheim, Germany </td> </tr> <tr> <td colspan="2"> FULL NAME OF SECOND JOINT INVENTOR (IF ANY) Peter CRAWENHOF </td> <td> INVENTOR'S SIGNATURE <i>Peter Cramenhof</i> </td> <td> DATE 19.04.01 </td> </tr> <tr> <td colspan="2"> RESIDENCE (City and either State or Foreign Country) D-89168 Niederstotzingen, Germany </td> <td colspan="2"> COUNTRY OF CITIZENSHIP Germany </td> </tr> <tr> <td colspan="4"> POST OFFICE ADDRESS Im Larchenbühl 26, D-89168 Niederstotzingen, Germany </td> </tr> </table>				COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. 119	Germany	299 14 893.9	25 August 1999	YES <u>X</u> NO _____	Germany	199 53 963.4	9 November 1999	YES <u>X</u> NO _____				YES _____ NO _____	UNITED STATES APPLICATION NUMBER	DATE OF FILING (day, month, year)	STATUS (patented, pending, abandoned)										FULL NAME OF SOLE OR FIRST INVENTOR Hans LINDENTHAL		INVENTOR'S SIGNATURE <i>Hans Lindenthal</i>	DATE 19. April 2001	RESIDENCE (City and either State or Foreign Country) D-89522 Heidenheim, Germany		COUNTRY OF CITIZENSHIP Germany		POST OFFICE ADDRESS Kistelbergstrasse 81, D-89522 Heidenheim, Germany				FULL NAME OF SECOND JOINT INVENTOR (IF ANY) Peter CRAWENHOF		INVENTOR'S SIGNATURE <i>Peter Cramenhof</i>	DATE 19.04.01	RESIDENCE (City and either State or Foreign Country) D-89168 Niederstotzingen, Germany		COUNTRY OF CITIZENSHIP Germany		POST OFFICE ADDRESS Im Larchenbühl 26, D-89168 Niederstotzingen, Germany			
COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. 119																																																				
Germany	299 14 893.9	25 August 1999	YES <u>X</u> NO _____																																																				
Germany	199 53 963.4	9 November 1999	YES <u>X</u> NO _____																																																				
			YES _____ NO _____																																																				
UNITED STATES APPLICATION NUMBER	DATE OF FILING (day, month, year)	STATUS (patented, pending, abandoned)																																																					
FULL NAME OF SOLE OR FIRST INVENTOR Hans LINDENTHAL		INVENTOR'S SIGNATURE <i>Hans Lindenthal</i>	DATE 19. April 2001																																																				
RESIDENCE (City and either State or Foreign Country) D-89522 Heidenheim, Germany		COUNTRY OF CITIZENSHIP Germany																																																					
POST OFFICE ADDRESS Kistelbergstrasse 81, D-89522 Heidenheim, Germany																																																							
FULL NAME OF SECOND JOINT INVENTOR (IF ANY) Peter CRAWENHOF		INVENTOR'S SIGNATURE <i>Peter Cramenhof</i>	DATE 19.04.01																																																				
RESIDENCE (City and either State or Foreign Country) D-89168 Niederstotzingen, Germany		COUNTRY OF CITIZENSHIP Germany																																																					
POST OFFICE ADDRESS Im Larchenbühl 26, D-89168 Niederstotzingen, Germany																																																							

UNITED STATES OF AMERICA COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION	OFGS FILE NO. P/3013-6
---	---------------------------

As a below named inventor, I hereby declare that: my residence, post office address and citizenship are as stated below next to my name; that I verily believe that I am the original, first and sole inventor (if only one name is listed below) or a joint inventor (if plural inventors are named) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

ARTICULATED YOKE, METHOD FOR THE PRODUCTION OF A SUPPORTING SURFACE
ENABLING AN EVEN DISTRIBUTION OF LOAD AND BEARING ARRANGEMENT

the specification of which is attached hereto, unless the following box is checked:

☒ was filed on 23 August 2000 as United States patent Application Number or PCT International patent application number PCT/EP00/08232 and was amended on _____ (if any).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose all information known to be material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim priority benefits under Title 35, United States Code §119 of any foreign application(s) for patent or inventor's certificate or United States provisional application(s) listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign or Provisional Application(s)

COUNTRY	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. 119
Germany	299 14 893.9	25 August 1999	YES <u>X</u> NO ____
Germany	199 53 963.4	9 November 1999	YES <u>X</u> NO ____
			YES ____ NO ____

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

UNITED STATES APPLICATION NUMBER	DATE OF FILING (day, month, year)	STATUS (patented, pending, abandoned)

I hereby appoint customer no. 2352 OSTROLENK, FABER, GERB & SOFFEN, LLP, and the members of the firm, Samuel H. Weiner - Reg. No. 18,510; Jerome M. Berliner - Reg. No. 18,653; Robert C. Faber - Reg. No. 24,322; Edward A. Meilman - Reg. No. 24,735; Steven I. Weisburd - Reg. No. 27,409; Max Moskowitz - Reg. No. 30,576; Stephen A. Soffen - Reg. No. 31,063; James A. Finder - Reg. No. 30,173; William O. Gray, III - Reg. No. 30,944; Louis C. Dujmich - Reg. No. 30,625; Douglas A. Miro - Reg. No. 31,643, and Michael J. Scheer - Reg. No. 34,425, as attorneys with full power of substitution and revocation to prosecute this application, to transact all business in the Patent & Trademark Office connected therewith and to receive all correspondence.

SEND CORRESPONDENCE TO: **OSTROLENK, FABER, GERB & SOFFEN, LLP** DIRECT TELEPHONE CALLS TO:
 1180 AVENUE OF THE AMERICAS (212) 382-0700
 NEW YORK, NEW YORK 10036-8403
 CUSTOMER NO. 2352

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FULL NAME OF SOLE OR FIRST INVENTOR Hans LINDENTHAL	INVENTOR'S SIGNATURE	DATE
--	----------------------	------

RESIDENCE (City and either State or Foreign Country) D-89522 Heidenheim, Germany	COUNTRY OF CITIZENSHIP Germany
---	-----------------------------------

POST OFFICE ADDRESS Kistelbergstrasse 81, D-89522 Heidenheim, Germany
--

FULL NAME OF SECOND JOINT INVENTOR (IF ANY) Peter GRAWENHOF	INVENTOR'S SIGNATURE	DATE
--	----------------------	------

RESIDENCE (City and either State or Foreign Country) D-89168 Niederstotzingen, Germany	COUNTRY OF CITIZENSHIP Germany
---	-----------------------------------

POST OFFICE ADDRESS Im Lerchenbuhl 26, D-89168 Niederstotzingen, Germany
